A. Claim 1

Claim 1, as amended, calls for a rigid base, a substrate mounting surface that is vertically movable relative to the base, and a retaining ring to maintain a substrate beneath the mounting surface during polishing. The retaining ring includes a lower portion made of plastic with a bottom surface for contacting a polishing pad during polishing, and an upper portion made of a metal which is more rigid than the plastic with a bottom surface joined to the lower portion and a top surface fixed to and abutting the base.

Kubo teaches an assembly 12 that includes a retaining ring 4, a rigid insert ring 6 and compressible backup ring 5 arranged in a stack secured that is secured to a plate 9. Kubo discloses that materials for the retaining ring 4 can include flouride resin, polyolefin, polyoxymethylene and polyimide.

Thus, the top surface of Kubo's rigid insert ring 6 contacts the compressible backup ring 5, rather than being fixed to and abutting a rigid base, as recited in claim 1.

The Examiner states "Kim teaches constructing a two-part retaining ring with plastic and stainless steel." Applicant disagrees, and requests that the Examiner point to the specific column and line number for this teaching. Figure 3 shows a unitary retaining ring 38; Figure 7 shows a unitary retaining ring 200; Figure 11 shows a unitary retainer ring 300; Figure 12 shows a unitary retainer ring 200 secured to a pressure plate 28. Thus, Kim does not teach a two-part retaining ring. Kim certainly fails to teach a carrier head with a retaining ring that has annular lower portion formed of plastic and an annular upper portion formed of metal and fixed to and abutting a rigid base.

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Machine Design and *DSM* teach the use of solid PPS retaining rings. *Machine Design* and *DSM* do not teach a retaining ring that has annular lower portion formed of plastic and an annular upper portion formed of metal and fixed to and abutting a rigid base.

Moreover, the combination of Kubo with Kim, *Machine Design* and *DSM* would not result in the claimed subject matter. Kim, *Machine Design* and *DSM* each teach a unitary retaining ring. Kubo teaches a three-piece assembly with a compressible backup ring positioned between the rigid insert ring and the retaining ring. There is no suggestion from the unitary structures of Kim, *Machine Design* or *DSM* to modify Kubo to create a retaining ring that has

annular lower portion formed of plastic and an annular upper portion formed of metal and fixed to and abutting a rigid base.

In fact, Kubo actually teaches away from the claimed subject matter. Kubo states that the backup ring needs to be easily compressible so that when the thickness of the workpiece is reduced by polishing, the thickness of the backup ring changes to keep the surface 4a of the retainer ring 4 at substantially the same level as the surface 7a of the workpiece 7 (see column 6, lines 11-16). Thus, Kubo specifically teaches that a compressible layer is needed between the rigid insert ring 6 and the plate 8. Consequently, Kubo teaches away from a system in which a metal upper portion of the retaining ring is fixed to and abuts a rigid base.

Since Kubo, Kim, *Machine Design* and *DSM*, either singly or in combination, fail to teach or suggest a retaining ring having a lower portion made of plastic and an upper portion made of metal which is more rigid than the plastic with a bottom surface joined to the lower portion and a top surface fixed to and abutting a rigid base, claim 1, and the claims depending therefrom, should be patentable.

B. Claim 13

Claim 13 as amended calls for a retaining ring having a generally annular lower portion and a generally annular upper portion having a bottom surface secured to the lower portion and a top surface having a top surface configured to be mechanically affixed to and abut a rigid base of a carrier head. The upper portion is more rigid than the lower portion.

The combination of Kubo with Kim, *Machine Design* and *DSM* would not result in the subject matter of claim 13. Kim, *Machine Design* and *DSM* each teach a unitary retaining ring. Kubo teaches a three-piece assembly with a compressible backup ring positioned between the rigid insert ring and the retaining ring. There is no suggestion from the unitary structures of Kim, *Machine Design* or *DSM* to modify Kubo to create a retaining ring that has annular lower portion formed an annular upper portion which is more rigid than the lower portion and which has a top surface configured to be mechanically affixed to and abut a rigid base of a carrier head.

Therefore claim 13, and the claims depending therefrom, should be patentable.

C. Claim 25

New claim 25 calls for a retaining ring with a generally annular lower portion having a bottom surface for contacting a polishing pad during polishing and a generally annular upper portion having a bottom surface secured to the lower portion and a top surface having a top surface configured to be mechanically affixed to and abut a rigid base of a carrier head. The lower portion made of a first material that is substantially inert to a chemical mechanical polishing process and has a durometer measurement between about 80 and 95 on the Shore D scale and a first thickness between 100 and 400 mils, and the upper portion is made of a second material which is more rigid than the first material and has a second thickness greater than the first thickness and an elastic modulus about ten to one-hundred times the elastic modulus of the first material.

The combination of Kubo with Kim, *Machine Design* and *DSM* would not result in the subject matter of claim 25.

First, as discussed above with respect to claim 13, Kim, *Machine Design* and *DSM* each teach a unitary retaining ring, whereas Kubo teaches a three-piece assembly with a compressible backup ring positioned between the rigid insert ring and the retaining ring. There is no suggestion from the unitary structures of Kim, *Machine Design* or *DSM* to modify Kubo to create a retaining ring that has annular lower portion formed of plastic and an annular portion with a top surface configured to be mechanically affixed to and abut a rigid base of a carrier head.

Second, the combination of Kubo with Kim, *Machine Design* and *DSM* fails to teach the combination of physical properties recited in claim 25. Claim 25 specifies that the lower portion has a thickness between about 100 and 400 mils, that the upper portion has a thickness greater than the thickness of the first portion, and that the material of the upper portion has an elastic modulus about ten to one-hundred times the elastic modulus of the material of the lower portion.

The Examiner argues that that dimensions of the lower portion are an obvious matter of design choice, citing *Gardner v. TEC Systems, Inc.* for the proposition that "where the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct."

However, in the present case, the combination of claimed physical properties do cause the ring to perform differently than the prior art device.

With respect to the thickness of the lower layer, the specification notes that "if the lower portion is too thick, the bottom surface of the retaining ring will be subject to deformation due to the flexible nature of the lower portion" (see page 12, lines 19-22), and then discusses the thickness ranges appropriate to avoid this effect. In contrast, the PPS rings described in *Machine Design* and *DSM* are unitary rings which will be considerably thicker (i.e., on par with the total combined thickness of the upper and lower layers). Thus, the claimed "first thickness between 100 and 400 mils" does cause the ring to operate differently than the thicker unitary PPS rings described in *Machine Design* and *DSM*.

With regard to the relative thickness of the upper and lower portion, Kubo teaches that the insert layer 6 is thinner than the retainer ring 4 (see column 7, lines 15 and 25, specifying a thickness of 5 mm for the retaining ring and 0.65 mm for the insert ring). In contrast, the claim calls for the upper portion to be thicker than the lower portion.

With regard to the relative elastic modulus, the Examiner argues that "inherently the elastic modulus of the metal is greater than that of the plastic PPS." Even assuming arguendo that the Examiner is correct, this fails to teach the specific limitation of the second material having "an elastic modulus about ten to one-hundred times the elastic modulus of the first material."

Moreover, the combination of physical properties provides a retaining ring that can operate differently than the prior art. As the Examiner will understand, the overall rigidity of the retaining ring is determined by the elastic moduli and thicknesses of both the upper and lower portions. The specification notes that "if the retaining ring is relative flexible, it can be deformed where it is joined to the base, e.g., by bolts 194. This deformation causes a non-planar bottom surface, thereby increasing the edge effect" but that "[o]n the other hand, an entirely rigid retaining ring ... can cause the substrate to crack." The combination of physical properties recited in claim 25 can result in a retaining ring that is neither too rigid nor too flexible, thereby providing a retaining ring which can reduce pad deformation, sensitivity to pad compressibility, and the edge effect (see page 15, lines 15-18) while avoiding chipping or cracking of the substrate edge (see page 14, line 24).

Therefore claim 25, and the claims depending therefrom, should be patentable.

Applicant asks that all claims be allowed. Enclosed is a $1100 check, including $180 for excess claim fees and $920.00 for the Petition for Extension of Time fee. Please apply any other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: 11/8/02

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Version with markings to show changes made

In the specification:

Paragraph beginning at page 1 line 2 has been amended as follows:

This application is a continuation application of and claims priority to U.S. Patent Application Serial No. 09/090,679, filed June 3, 1998, issued as U.S. Patent No. 6,251,215.

In the claims:

Claims 1, 3-5 and 13 have been amended as follows:

1. (Amended) A carrier head for a chemical mechanical polishing apparatus, comprising:

a rigid base;

a substrate mounting surface that is vertically movable relative to the base; and

a retaining ring to maintain a substrate beneath the mounting surface during polishing, the retaining ring including

a substantially annular lower portion having a bottom surface for contacting a polishing pad during polishing, [and an upper portion secured to the lower portion,] wherein the lower portion is made of a plastic, [having a durometer measurement between about 80 and 95 on the Shore D scale] and

a substantially annular upper portion having a bottom surface joined to the lower portion and a top surface fixed to and abutting the base, wherein the upper lower portion is made of a metal which is more rigid than the plastic.

3. (Amended) The carrier head of claim 1, wherein the lower portion [is thicker than a substrate to be polished] has a durometer measurement between about 80 and 95 on the Shore D scale.

4. (Amended) The carrier head of claim [3] 1, wherein the lower portion is between about 100 and 400 mils thick.

5. (Amended) The carrier head of claim [1] 4, wherein the upper [and lower portions are substantially annular in shape] portion is thicker than the lower portion.

13. (Amended) A retaining ring for a carrier head having a mounting surface for a substrate, comprising:

a generally annular lower portion having a bottom surface for contacting a polishing pad during polishing, the lower portion made of a plastic [having a durometer measurement between about 80 and 95 on the Shore D scale]; and

a generally annular upper portion having a bottom surface secured to the lower portion and a top surface having a top surface configured to be mechanically affixed to and abut a rigid base of a carrier head, wherein [and] the upper [lower] portion is made of a metal which is more rigid than the plastic.

Please add claims 14-30.

14. The retaining ring of claim 13, wherein the plastic is substantially inert to a chemical mechanical polishing process.

15. The retaining ring of claim 13, wherein the lower portion has a durometer measurement between about 80 and 95 on the Shore D scale.

16 The retaining ring of claim 13, wherein the lower portion is between about 100 and 400 mils thick.

17. The retaining ring of claim 16, wherein the upper portion is thicker than the lower portion.

18. The retaining ring of claim 13, wherein the plastic is selected from the group consisting of polyphenylene sulfide, polyethylene terephthalate, polyetheretherketone, and polybutylene terephthalate.

19. The retaining ring of claim 18, wherein the plastic is polyphenylene sulfide.

20. The retaining ring of claim 13, wherein the metal is selected from the group consisting of steel, aluminum, and molybdenum.

21. The retaining ring of claim 13, wherein the metal material has an elastic modulus about ten to one-hundred times the elastic modulus of the plastic material.

22. The retaining ring of claim 13, wherein the lower portion is adhesively attached to the upper portion.

23. The retaining ring of claim 22, wherein the adhesive is a slow curing epoxy.

24. The retaining ring of claim 13, wherein the lower portion is press fit to the upper portion.

25. A retaining ring for a carrier head having a mounting surface for a substrate, comprising:

a generally annular lower portion having a bottom surface for contacting a polishing pad during polishing, the lower portion made of a first material that is substantially inert to a chemical mechanical polishing process and has a durometer measurement between about 80 and 95 on the Shore D scale and a first thickness between 100 and 400 mils; and

a generally annular upper portion having a bottom surface secured to the lower portion and a top surface having a top surface configured to be mechanically affixed to and abut a rigid base of a carrier head, wherein the upper portion is made of a second material which is more rigid than the first material and has a second thickness greater than the first thickness and an elastic modulus about ten to one-hundred times the elastic modulus of the first material.

26. The retaining ring of claim 25, wherein the first material is a plastic.

27. The retaining ring of claim 26, wherein the plastic is selected from the group consisting of polyphenylene sulfide, polyethylene terephthalate, polyetheretherketone, and polybutylene terephthalate.

28. The retaining ring of claim 27, wherein the plastic is polyphenylene sulfide.

29. The retaining ring of claim 25, wherein the second material is a metal.

30. The retaining ring of claim 25, wherein the metal is selected from the group consisting of steel, aluminum, and molybdenum.